

The documentation and process conversion measures necessary to comply with this revision shall be completed by 24 July 2003.

INCH-POUND

MIL-PRF-19500/538B
24 April 2003
SUPERSEDING
MIL-PRF-19500/538A
30 July 1999

PERFORMANCE SPECIFICATION

* SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, POWER
TYPE 2N6676, 2N6678, 2N6676T1, 2N6678T1, 2N6676T3, 2N6678T3, 2N6691 AND 2N6693 JAN, JANTX AND JANTXV

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for NPN silicon, power transistors. Three levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

* 1.2 Physical dimensions. See figure 1 (TO-3) - 2N6676, 2N6678; figure 2 (TO-63) - 2N6691, 2N6693, figure 3 (TO-254AA) - 2N6676T1, 2N6678T1, and figure 4 (TO-257AA) - 2N6676T3, 2N6678T3.

* 1.3 Maximum ratings.

Types	P_T $T_A = +25^\circ\text{C}$	P_T $T_C = +25^\circ\text{C}$ (1)	V_{CBO} and V_{CEX}	V_{CEO}	V_{EBO}	I_B	I_C	T_J and T_{STG}
	<u>W</u>	<u>W</u>	<u>V dc</u>	<u>V dc</u>	<u>V dc</u>	<u>A dc</u>	<u>A dc</u>	<u>°C</u>
2N6676, 2N6676T1	6	175	450	300	8.0	5	15	-65 to +200
2N6678, 2N6678T1	6	175	650	300	8.0	5	15	-65 to +200
2N6676T3	4	125 (2)	450	400	8.0	5	15	-65 to +200
2N6678T3	4	125 (2)	650	400	8.0	5	15	-65 to +200
2N6691	6	175	450	300	8.0	5	15	-65 to +200
2N6693	6	175	650	400	8.0	5	15	-65 to +200

- (1) See figures 5 and 6 for temperature-power derating curves.
(2) For TO-257 devices with typical mounting and small footprint, conservatively rated at 125 W and 1.3°C/W only.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center, Columbus, ATTN: DSCC-VAC, P. O. Box 3990, Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

* 1.4 Primary electrical characteristics at $T_C = +25^\circ\text{C}$.

Limits	h_{FE1} $V_{CE} = 3 \text{ V dc}$ $I_C = 1 \text{ A dc}$ (1)	h_{FE2} $V_{CE} = 3 \text{ V dc}$ $I_C = 15 \text{ A dc}$ (1)	$V_{BE(sat)}$ $I_C = 15 \text{ A dc}$ $I_B = 3 \text{ A dc}$	$V_{CE(sat)}$ $I_C = 15 \text{ A dc}$ $I_B = 3 \text{ A dc}$	$R_{\theta JC}$ (2) All devices except T3 suffix	$R_{\theta JC}$ (2) 2N6676T3, 2N6678T3 only
Min	15	8	<u>V dc</u>	<u>V dc</u>	<u>$^\circ\text{C/W}$</u>	<u>$^\circ\text{C/W}$</u>
Max	40	20	1.5	1.0	1.0	1.3

Limits	$ h_{fe} $ $V_{CE} = 10 \text{ V dc}$ $I_C = 1 \text{ A dc}$ $f = 5 \text{ MHz}$	C_{obo} $V_{CB} = 10 \text{ V dc}$ $I_E = 0$ $100 \text{ KHz} < f < 1 \text{ MHz}$	Switching (3)				
			t_c	t_d	t_r	t_s	t_f
		<u>pF</u>	<u>μs</u>	<u>μs</u>	<u>μs</u>	<u>μs</u>	<u>μs</u>
Min	3	150					
Max	10	500	0.5	0.1	0.6	2.5	0.5

(1) Pulsed (see 4.5.1).

(2) See figures 7 through 10, thermal impedance graphs.

(3) See figure 11 (pulse response circuits).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

DEPARTMENT OF DEFENSE

MIL-PRF-19500 - Semiconductor Devices, General Specification for.

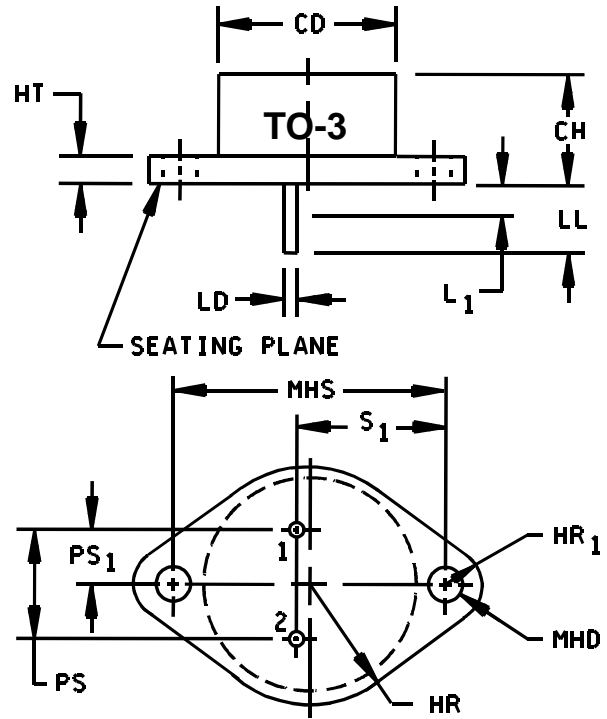
STANDARD

MILITARY

MIL-STD-750 - Test Methods for Semiconductor Devices.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Document Automation and Production Services (DAPS), Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

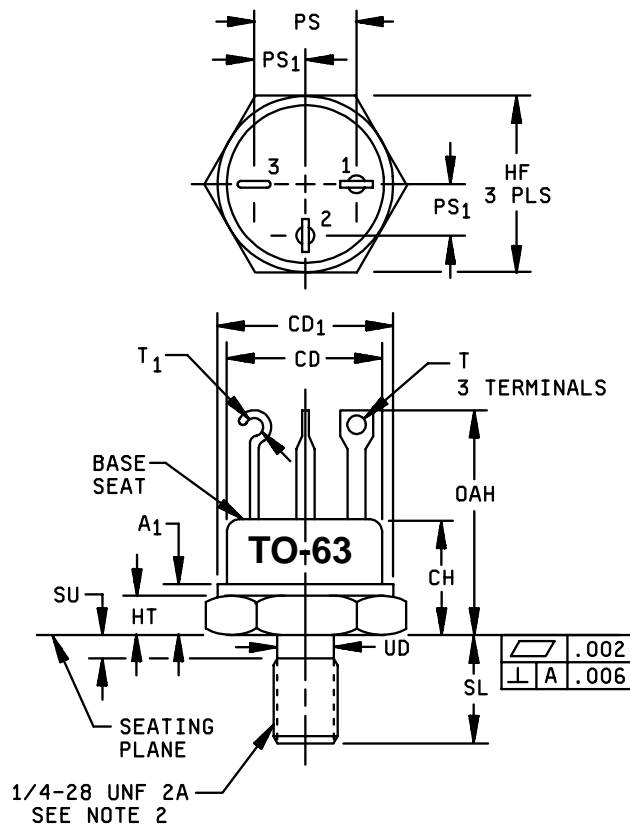
Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD		.875		22.22	3
CH	.270	.380	6.86	9.65	
HR	.495	.525	12.57	13.34	
HR1	.131	.188	3.33	4.78	
HT	.060	.135	1.52	3.43	
L1		.050		1.27	5, 9
LD	.038	.043	0.97	1.09	5, 9
LL	.312	.500	7.92	12.70	5
MHD	.151	.161	3.84	4.09	7
MHS	1.177	1.197	29.90	30.40	
PS	.420	.440	10.67	11.18	4
PS1	.205	.225	5.21	5.72	4, 5
S	.655	0.675	16.64	17.14	4



NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Body contour is optional within zone defined by CD
4. These dimensions shall be measured at points .050 inch (1.27 mm) to .055 inch (1.40 mm) below seating plane. Measurement shall be made at seating plane.
5. Both terminals.
6. At both ends.
7. Two holes.
8. Terminal 1 is the emitter, terminal 2 is base. The collector shall be electrically connected to the case.
9. LD applies between L1 and LL. Diameter is uncontrolled in L1.
10. In accordance with ASME Y14.5M, diameters are equivalent to ϕ x symbology.

* FIGURE 1. Physical dimensions (T0-3) for 2N6676 and 2N6678.

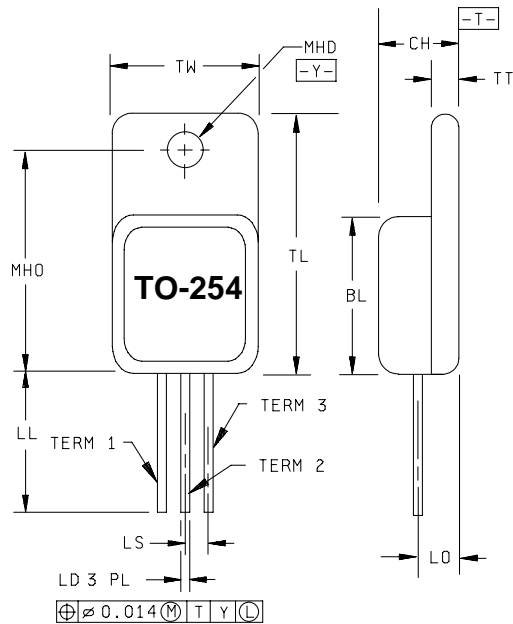


Ltr	Dimension				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
A ₁		.270		6.86	
CD	.570	.610	14.48	15.49	
CD ₁	.610	.687	15.49	17.45	
CH	.325	.460	8.26	11.68	
HF	.667	.687	16.94	17.45	
HT	.090	.150	2.29	3.81	
OAH	.640	.875	16.26	22.22	4
PS	.340	.415	8.64	10.54	3, 6
PS ₁	.170	.213	4.32	5.41	3, 6
SL	.422	.455	10.72	11.56	
SU		.090		2.29	7
T	.047	.072	1.19	1.83	
T ₁	.046	.077	1.17	1.96	
UD	.220	.249	5.59	6.32	

NOTES:

1. Dimensions are in inches, metric equivalents are given for general information only.
2. See NSB Handbook H28, "Screw-Thread Standards for Federal Services".
3. The orientation of the terminals in relation to the hex flats is not controlled.
4. All three terminals.
5. The case temperature may be measured anywhere on the seating plane within .125 inch (3.18 mm) of the stud.
6. Terminal spacing measured at the base seat only.
7. This dimension applies to the location of the center line of the terminals.
8. Terminal - 1, emitter; terminal - 2, base; terminal - 3, collector. all leads are isolated from the case.
9. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

* FIGURE 2. Physical dimensions (TO-63) for 2N6691 and 2N6693.

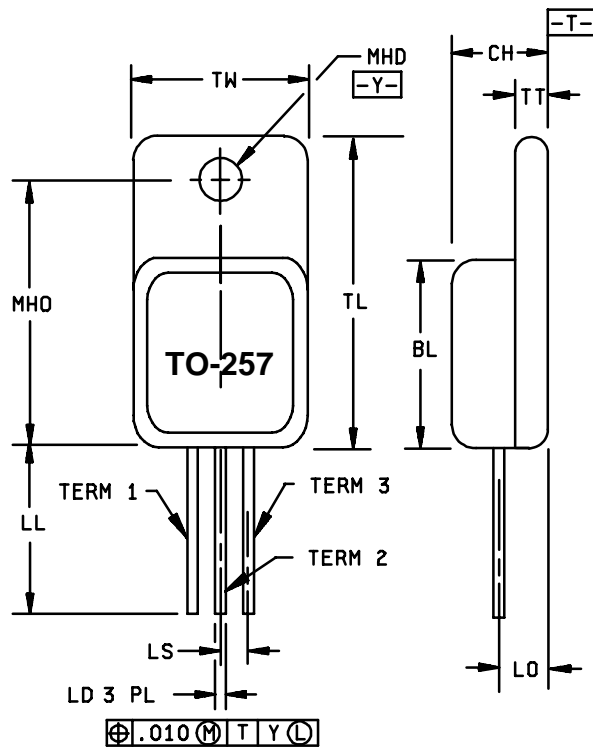


Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
BL	.535	.545	13.59	13.89
CH	.249	.260	6.32	6.60
LD	.035	.045	0.89	1.43
LL	.530	.550	13.46	13.97
LO	.150 BSC		3.81 BSC	
LS	.150 BSC		3.81 BSC	
MHD	.139	.149	3.53	3.78
MHO	.665	.685	16.89	17.40
TL	.790	.800	20.07	20.32
TT	.040	.050	1.02	1.27
TW	.535	.545	13.59	13.89
Term 1	Base			
Term 2	Collector			
Term 3	Emitter			

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Methods used for electrical isolation of the terminals feedthroughs shall employ materials that contain a minimum of 90 percent AL₂O₃ (ceramic).
4. All terminals are isolated from case.
5. In accordance with ASME Y14.5M, diameters are equivalent to ϕ x symbology.

* FIGURE 3. Dimensions and configuration for 2N6676T1 and 2N6678T1 (T0-254AA).



Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
BL	.410	.430	10.41	10.92
CH	.190	.200	4.83	5.08
LD	.025	.035	0.64	0.89
LL	.500	.750	12.70	19.05
LO	.120 BSC		3.05 BSC	
LS	.100 BSC		2.54 BSC	
MHD	.140	.150	3.56	3.81
MHO	.527	.537	13.39	13.63
TL	.645	.665	16.38	16.89
TT	.035	.045	0.89	1.14
TW	.410	.420	10.41	10.67
Term 1	Base			
Term 2	Collector			
Term 3	Emitter			

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Methods used for electrical isolation of the terminals feedthroughs shall employ materials that contain a minimum of 90 percent AL₂O₃ (ceramic).
4. In accordance with ASME Y14.5M, diameters are equivalent to ϕ x symbology.

* FIGURE 4. Dimensions and configuration for 2N6676T3 and 2N6678T3 (TO-257AA).

* 2.2 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

* 3.1 General. The individual item requirements shall be as specified in MIL-PRF-19500 and as modified herein.

* 3.2 Qualification. Devices furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturer's list (QML) before contract award (see 4.2 and 6.3).

* 3.3 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500 and as follows:

V_{CEX} - Collector cutoff voltage (dc) with specified circuit between base and emitter.

R_{ISO} - Resistance between device case and leads

* 3.4 Interface requirements and physical dimensions. The Interface requirements and physical dimensions shall be as specified in MIL-PRF-19500 and figure 1 (TO-3) - 2N6676, 2N6678; figure 2 (TO-61) - 2N6691, 2N6693; figure 3 (TO-254AA) - 2N6678T1; and figure 4 (TO-257AA) - 2N6678T3 herein.

3.4.1 Lead finish. Lead finish shall be solderable in accordance with MIL-PRF-19500. Where a choice of lead finish is desired, it shall be specified in the acquisition document (see 6.2).

3.5 Marking. Marking shall be in accordance with MIL-PRF-19500.

3.6 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in 1.3, 1.4, and table I herein.

3.7 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table I herein.

* 3.8 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

* 4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.2).
- b. Screening (see 4.3).
- c. Conformance inspection (see 4.4 and tables I, II, and III).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500, and as specified herein.

* 4.2.1 Group E qualification. Group E inspection shall be performed for qualification or re-qualification only. In case qualification was awarded to a prior revision of the associated specification that did not request the performance of table III tests, the tests specified in table III herein shall be performed by the first inspection lot of this revision to maintain qualification.

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* 4.3 Screening. Screening shall be in accordance with table IV of MIL-PRF-19500, and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screen (see table IV of MIL-PRF-19500)	Measurements
	JANTX, JANTXV levels
3a 3b 3c	Not applicable Not applicable Thermal impedance (transient), method 3131 of MIL-STD-750 (1)
9	I_{CEX1}
11	I_{CEX1} and h_{FE2} ; ΔI_{CEX1} = 100 percent of initial value or 50 μA dc, whichever is greater.
12	See 4.3.1
13	Subgroup 2 of table I herein; ΔI_{CEX1} = 100 percent of initial value or 50 μA dc, whichever is greater. $\Delta h_{FE2} = \pm 25$ percent of initial value.

(1) Thermal impedance limits ($Z_{\theta JC}$) shall not exceed the thermal impedance curves on figures 7, 8, 9, and 10.

* 4.3.1 Power burn-in conditions. Power burn-in conditions are: $T_J = +175^\circ C$ minimum, $V_{CB} \geq 100$ V dc; $T_A = +30^\circ C$ maximum.

* 4.3.2 Insulation resistance test. Isolation resistance test conditions are as follows: Method 1016 of MIL-STD-750, short collector, emitter and base terminals together. Limit is $10^9 \Omega$ minimum.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500, and as specified herein.

* 4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-PRF-19500 and table I herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

* 4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VIb (JAN, JANTX, and JANTXV) and in 4.4.2.1 herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein. Delta requirements shall be in accordance with table II herein.

* 4.4.2.1 Group B inspection, table VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500.

Subgroup	Method	Condition
B3	1027	For eutectic die attach: $V_{CB} \geq 100$ V dc; adjust P_T to achieve $T_J = +175^\circ C$ minimum; $T_A = +30^\circ C$ maximum
B3	1037	For solder die attach: 2,000 cycles, $V_{CB} \geq 100$ V dc.
B5	3131	See 4.5.2.

* 4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VII of MIL-PRF-19500 and herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein. Delta requirements shall be in accordance with table II herein.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Test condition A; weight = 10 pounds; time = 15 s.
C2	2036	Test condition D1; torque = 6 inch-ounce; time = 15 s.
C2	2036	Stud torque (2N6691, 2N6693 only), test condition D2; torque = 15 inch-pound; time = 15 s.
C6	1027	For eutectic die attach: $V_{CB} \geq 100$ V dc; adjust P_T to achieve $T_J = +175^\circ\text{C}$ minimum; $T_A = +30^\circ\text{C}$ maximum.
C6	1037	For solder die attach: 2,000 cycles, $V_{CB} \geq 100$ V dc.

* 4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table IX of MIL-PRF-19500 and as specified in table III herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

4.5 Method of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows.

4.5.1 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of MIL-STD-750.

* 4.5.2 Thermal resistance. Thermal resistance measurements shall be conducted in accordance with method 3131 of MIL-STD-750. The following details shall apply: $R_{\theta JC}$ = see figures 7, 8, 9, and 10, thermal impedance curves.

- a. Collector current magnitude during power application shall be 2.5 A dc.
- b. Collector to emitter voltage magnitude shall be 20 V dc.
- c. Reference temperature measuring point shall be the case.
- d. Reference point temperature shall be $+25^\circ\text{C}$ to $+75^\circ\text{C}$.
- e. Mounting arrangement shall be with heat sink to case.

* TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u> Visual and mechanical examination	2071					
<u>Subgroup 2</u> Collector to base breakdown voltage 2N6676, 2N6676T1 2N6676T3, 2N6691 2N6678, 2N6678T1 2N6678T3, 2N6693	3011	Bias condition D, $I_C = 200$ mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$	300 400		V dc V dc
Collector to emitter cutoff current 2N6676, 2N6676T1 2N6676T3, 2N6691 2N6678, 2N6678T1 2N6678T3, 2N6693	3041	Bias condition A, $V_{BE} = -1.5$ V dc $V_{CEX} = 450$ V dc $V_{CEX} = 650$ V dc	I_{CEX1}		0.1	mA dc
Collector to emitter cutoff current 2N6676, 2N6676T1 2N6676T3, 2N6691 2N6678, 2N6678T1 2N6678T3, 2N6693	3041	Bias condition A, $V_{BE} = -1.5$ V dc $V_{CEX} = 300$ V dc $V_{CEX} = 400$ V dc	I_{CEX2}		5 5	μ A μ A
Collector to base cutoff current 2N6676, 2N6676T1 2N6676T3, 2N6691 2N6678, 2N6678T1 2N6678T3, 2N6693	3036	Bias condition D; $V_{CBO} = 450$ V dc $V_{CBO} = 650$ V dc	I_{CBO}		1.0	mA dc
Emitter-base cutoff current	3061	Bias condition D, $V_{EB} = 8$ V dc	I_{EBO}		2.0	mA dc
Base emitter voltage	3066	Test condition A; $I_C = 15$ A dc; pulsed (see 4.5.1); $I_B = 3$ A dc	$V_{BE(sat)}$		1.5	V dc
Collector to emitter saturated voltage	3071	$I_C = 15$ A dc; pulsed (see 4.5.1) $I_B = 3$ A dc	$V_{CE(sat)1}$		1.0	V dc
Forward-current transfer ratio	3076	$V_{CE} = 3$ V dc; $I_C = 1$ A dc; pulsed (see 4.5.1)	h_{FE1}	15	40	
Forward-current transfer ratio	3076	$V_{CE} = 3$ V dc; $I_C = 15$ A dc; pulsed (see 4.5.1)	h_{FE2}	8	20	
Insulation resistance (2N6676T1, 2N6676T3, 2N6678T1, 2N6678T3, 2N6691 and 2N6693 only)	1016	See 4.3.2	R_{ISO}	1×10^9		Ω

See footnote at end of table.

* TABLE I. Group A inspection - Continued.

Inspection 1/ 	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 3</u>						
High-temperature operation:		T _A = +125°C				
Collector to emitter cutoff current 2N6676, 2N6676T1 2N6676T3, 2N6691 2N6678, 2N6678T1 2N6678T3, 2N6693	3041	Bias condition A; V _{BE} = -1.5 V dc V _{CEX} = 450 V dc V _{CEX} = 650 V dc	I _{CEX3}		1.0	mA dc
Collector to emitter saturated voltage	3071	I _C = 15 A dc; I _B = 3 A dc; pulsed (see 4.5.1)	V _{CE(sat)2}		2.0	V dc
Collector to emitter cutoff current 2N6676, 2N6676T1 2N6676T3, 2N6691 2N6678, 2N6678T1 2N6678T3, 2N6693	3041	Bias condition A, V _{BE} = -1.5 V dc V _{CEX} = 300 V dc V _{CEX} = 400 V dc	I _{CEX4}		90 90	μA μA
Low-temperature operation :		T _A = -55°C				
Forward-current transfer ratio	3076	V _{CE} = 3 V dc I _C = 15 A dc; pulsed (see 4.5.1)	h _{FE3}	4		
<u>Subgroup 4</u>						
Magnitude of common emitter small-signal short-circuit forward- current transfer ratio	3306	V _{CE} = 10 V dc; I _C = 1 A dc; f = 5 MHz	h _{fe}	3	10	
Open capacitance (open circuit)	3236	V _{CB} = 10 V dc; I _E = 0; 100 kHz ≤ f ≤ 1.0 MHz	C _{obo}	150	500	pF
Switching parameters:		T _A = +25°C				
Pulse delay time		See figure 11	t _d		0.1	μs
Pulse rise time		See figure 11	t _r		0.6	μs
Pulse storage time		See figure 11	t _s		2.5	μs
Pulse fall time		See figure 11	t _f		0.5	μs
Cross over time		See figure 11	t _c		0.5	μs
<u>Subgroup 5</u>						
Safe operating area (dc operation)	3051	T _C = +25°C t = 1 s; 1 cycle; (see figure 12)				
Test 1 (All device types)		V _{CE} = 11.7 V dc; I _C = 15 A dc				

See footnote at end of table.

* TABLE I. Group A inspection - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 5</u> - Continued <u>Test 2</u> (2N6676, 2N6678, 2N6676T1, 2N6676T3, 2N6678T1, 2N6678T3) <u>Test 3</u> (All device types) <u>Test 4</u> (2N6691, 2N6693) <u>Test 5</u> (2N6676, 2N6678, 2N6676T1, 2N6676T3, 2N6678T1, 2N6678T3) (2N6691, 2N6693) Safe operating area (clamped switching) 2N6676, 2N6676T1, 2N6676T3, 2N6691 2N6678, 2N6678T1, 2N6678T3, 2N6693 Electrical measurements <u>Subgroups 6 and 7</u> Not applicable	3053	$V_{CE} = 30 \text{ V dc}; I_C = 5.9 \text{ A dc}$ $V_{CE} = 100 \text{ V dc}; I_C = 0.25 \text{ A dc}$ $V_{CE} = 25 \text{ V dc}; I_C = 7 \text{ A dc}$ $V_{CE} = 300 \text{ V dc}; I_C = 20 \text{ mA dc}$ $V_{CE} = 400 \text{ V dc}; I_C = 10 \text{ mA dc}$ $T_A = +25^\circ\text{C}, V_{CC} = 15 \text{ V dc}$ (see figure 13); Load condition B, $V_{BB2} = 5.0 \text{ V}$, $R_{BB1} = 5 \Omega$; $R_{BB2} = 1.5 \Omega$; $L = 50 \mu\text{H}$; R of inductor $= 0.05 \Omega$, $R_{load} = R$ of inductor Clamp voltage $= 350 \text{ V dc}; I_C = 15 \text{ A dc}$ Clamp voltage $= 450 \text{ V dc}; I_C = 15 \text{ A dc}$ Table I, subgroup 2 herein.				

1/ For sampling plan see MIL-PRF 19500.

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* TABLE II. Groups A, B, and C delta electrical measurements. 1/ 2/ 3/

Steps	Inspection <u>1</u> /	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Collector to emitter cutoff current 2N6676, 2N6691, 2N6676T1, 2N6676T3, 2N6678, 2N6678T1, 2N6678T3, 2N6693	3041	Bias condition A; $V_{BE} = -1.5$ V dc $V_{CE} = 450$ V dc $V_{CE} = 650$ V dc	ΔI_{CEX1} <u>2</u> /	100 percent of initial value or 50 μ A whichever is greater.		
2.	Forward - current transfer ratio	3076	$V_{CE} = 3$ V dc; $I_C = 15$ A dc; pulsed (see 4.5.1)	Δh_{FE2}	± 25 percent change from initial reading.		
3.	Collector to emitter voltage (saturated)	3071	$I_C = 15$ A dc; $I_B = 3$ A dc, pulsed (see 4.5.1)	$\Delta V_{CE(sat)1}$	± 100 mV change from previously measured value.		

1/ Devices which exceed the group A limits for this test shall not be acceptable.

2/ The delta electrical measurements for table VIb (JAN, JANTX and JANTXV) of MIL-PRF-19500 are as follows:

- Subgroup 3, see table II herein, steps 1 and 2.
- Subgroup 6, see table II herein, step 2.

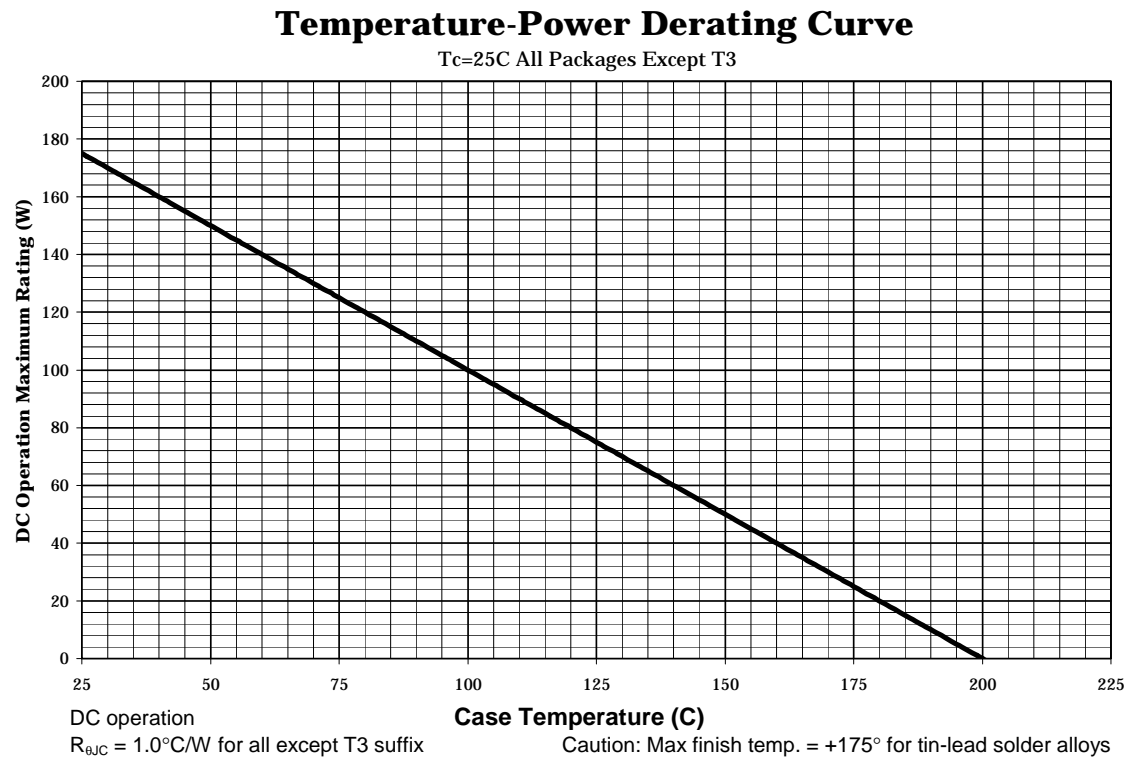
3/ The delta electrical measurements for table VII of MIL-PRF-19500 are as follows:

- Subgroup 2, see table II herein, step 1.
- Subgroup 3, see table II herein, step 1.
- Subgroup 6, see table II herein, steps 1, 2 and 3.

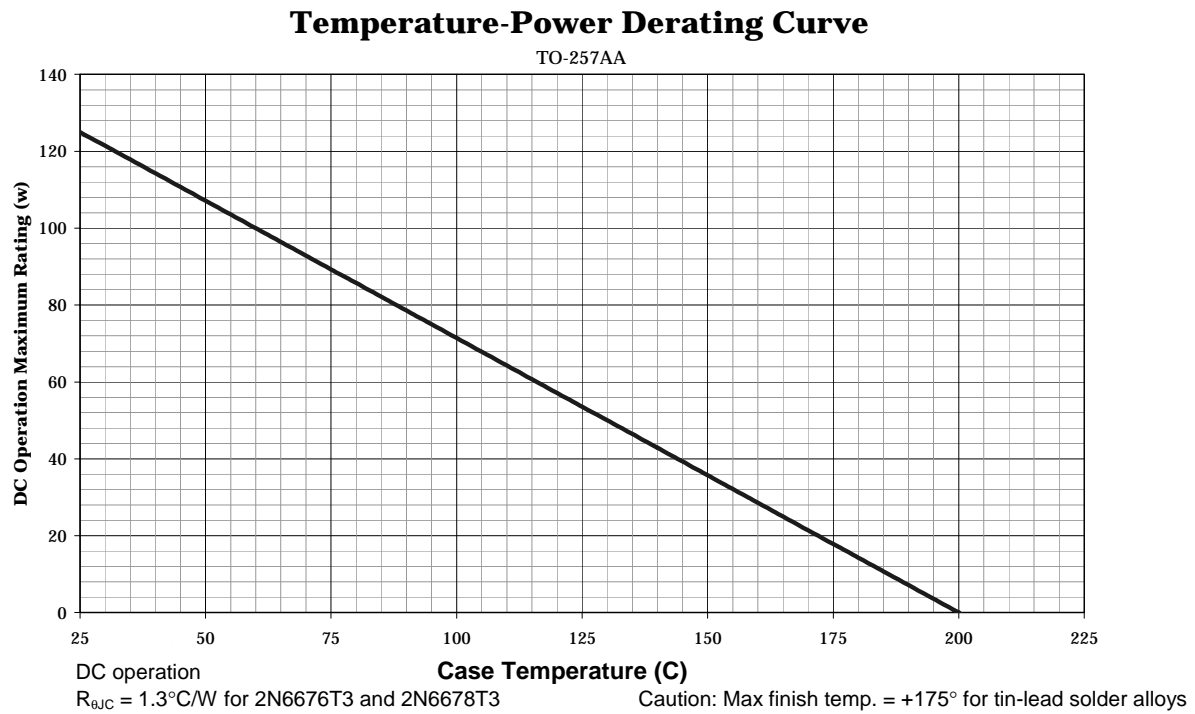
MIL-PRF-19500/538B

* TABLE III. Group E inspection (all quality levels) - for qualification and re-qualification only.

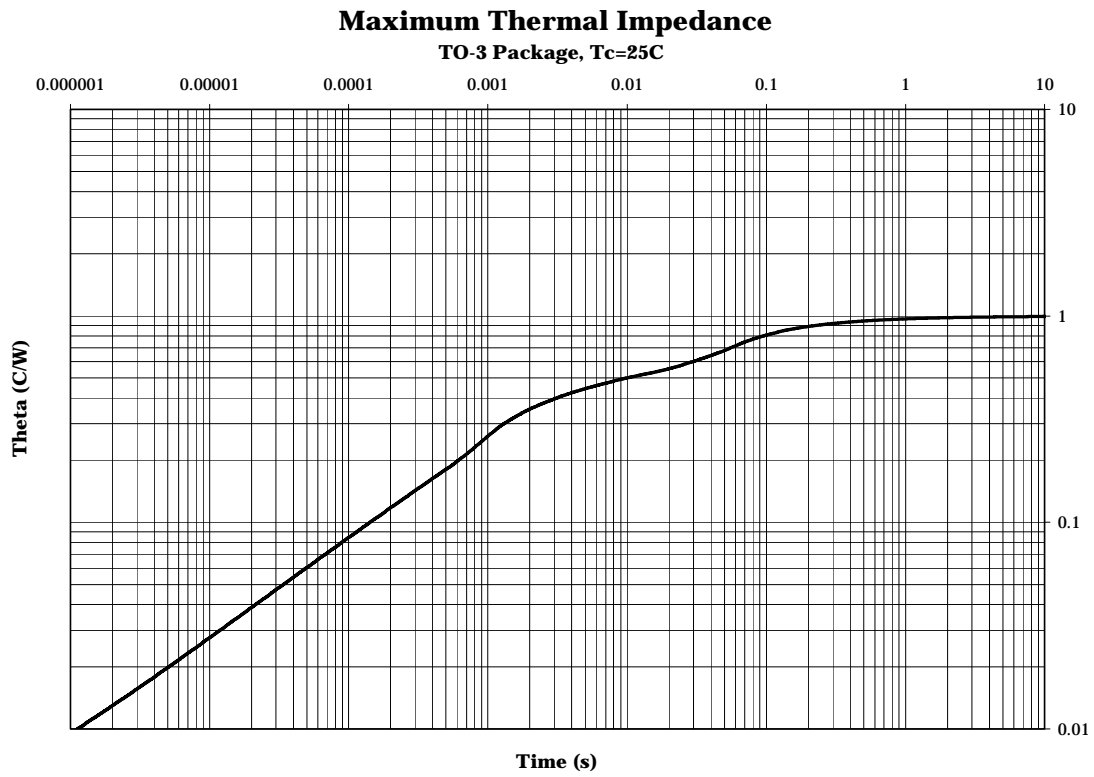
Inspection	MIL-STD-750		Qualification
	Method	Conditions	
<u>Subgroup 1</u>			45 devices c = 0
Thermal shock glass strain	1056	0°C to +100°C, 100 cycles	
Hermetic seal	1071		
Fine leak Gross leak			
Electrical measurements		See table I, subgroup 2 herein.	
<u>Subgroup 2</u>			45 devices c = 0
Steady-state dc blocking life	1039 or 1049	Condition A; 1,000 hrs	
Electrical measurements		See table I, subgroup 2 herein.	
<u>Subgroup 3</u>			3 devices c = 0
DPA	2102		
<u>Subgroup 4</u>			sample size N/A
Thermal impedance curves		Each supplier shall submit their (typical) design thermal impedance curves. In addition, test conditions and $Z_{\theta JX}$ limit shall be provided to the qualifying activity in the qualification report	
<u>Subgroups 5, 6, and 7</u>			
Not applicable			
<u>Subgroup 8</u>			45 devices c = 0
Reverse stability	1033	Condition A for devices ≥ 400 V, condition B for devices < 400 V.	



* FIGURE 5. Temperature derating graph (all except T3 (T0-257AA) packages).

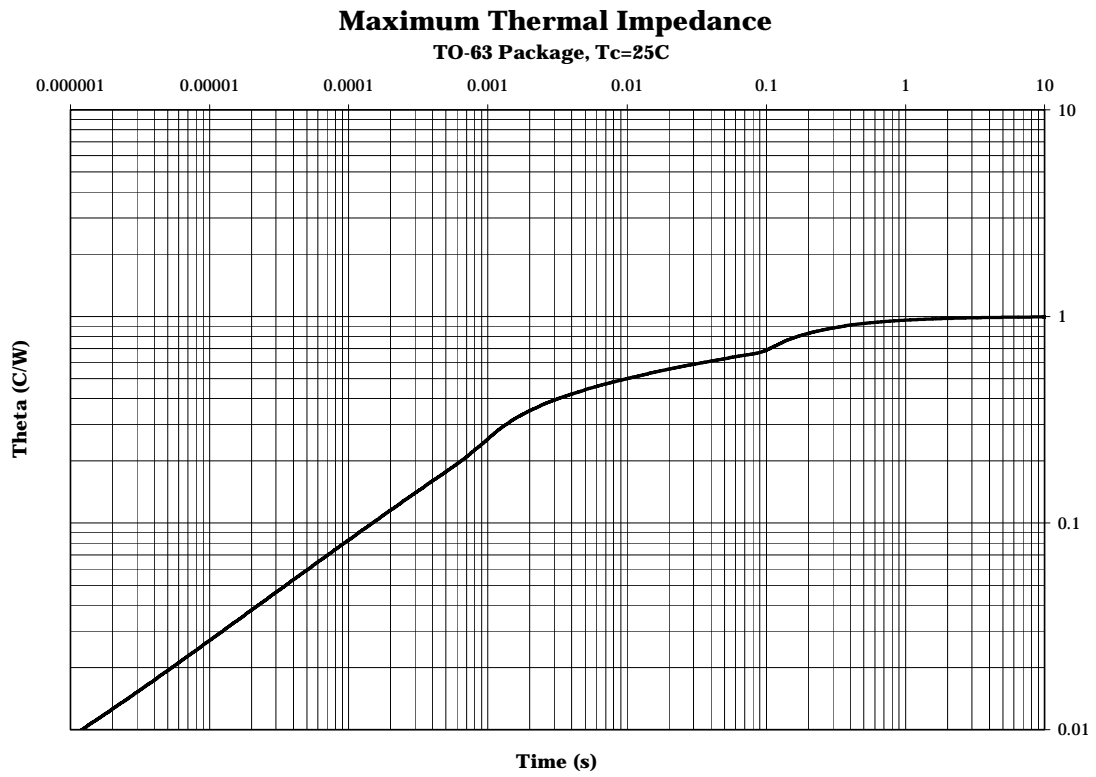


*FIGURE 6. Temperature derating graph for T3 (T0-257AA) packages.



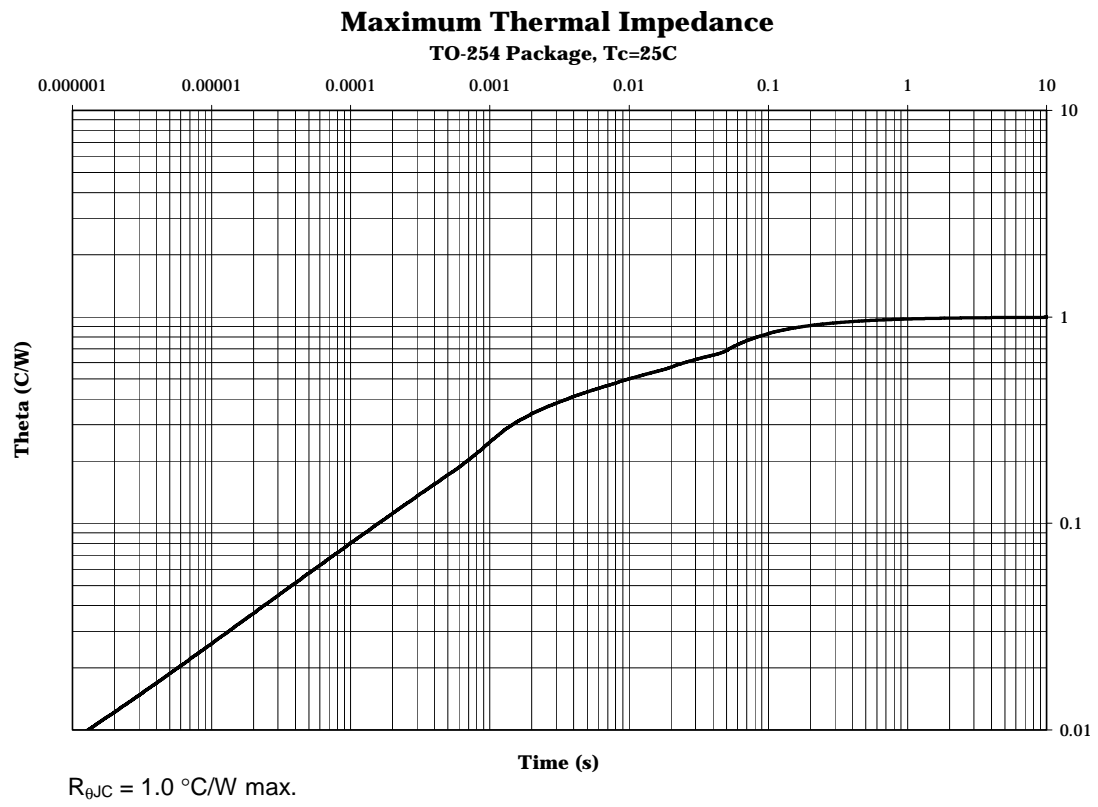
$R_{\theta JC} = 1.0 \text{ } ^\circ\text{C/W max.}$

* FIGURE 7. Thermal impedance graphs (2N6676 and 2N6678).

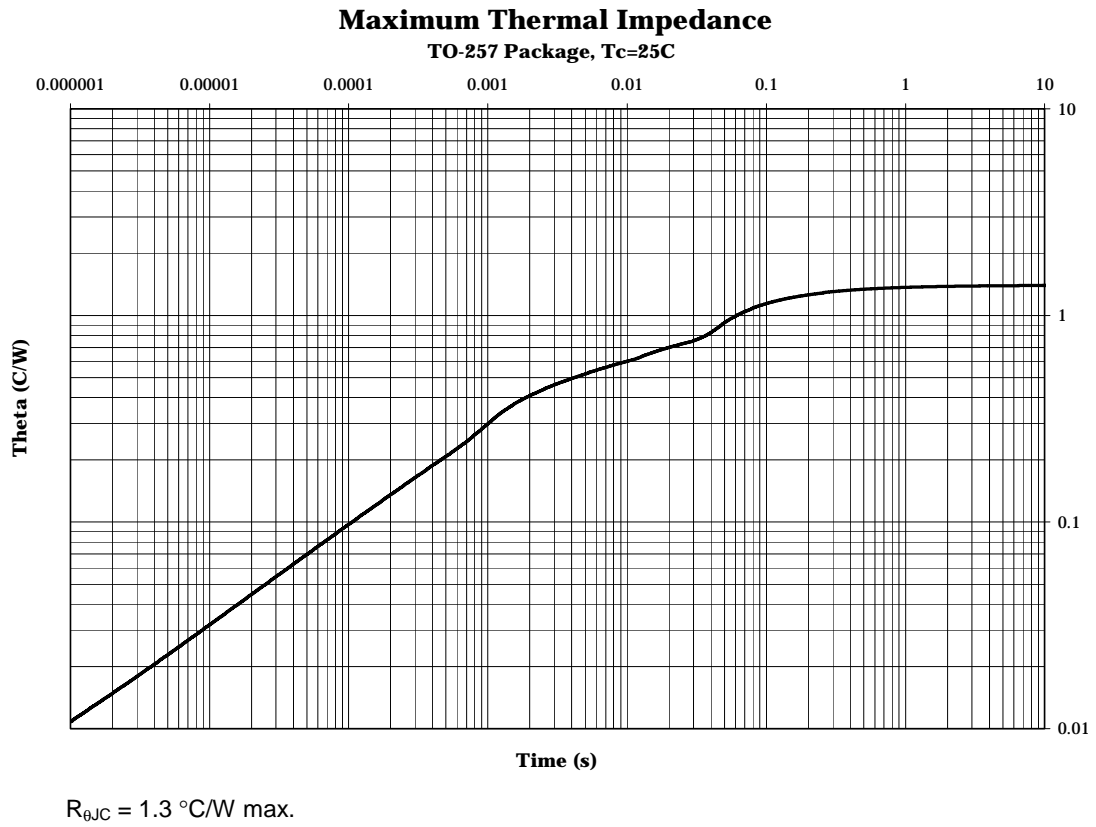


$R_{\theta JC} = 1.0\text{ }^{\circ}\text{C/W max.}$

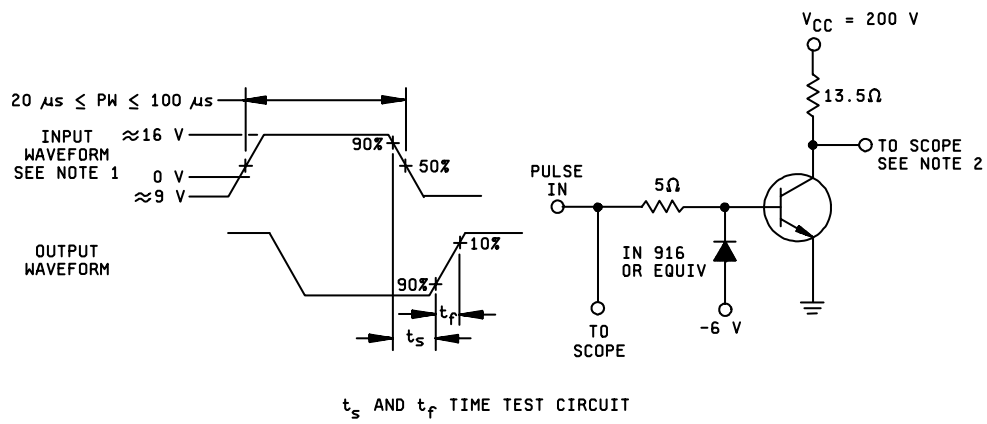
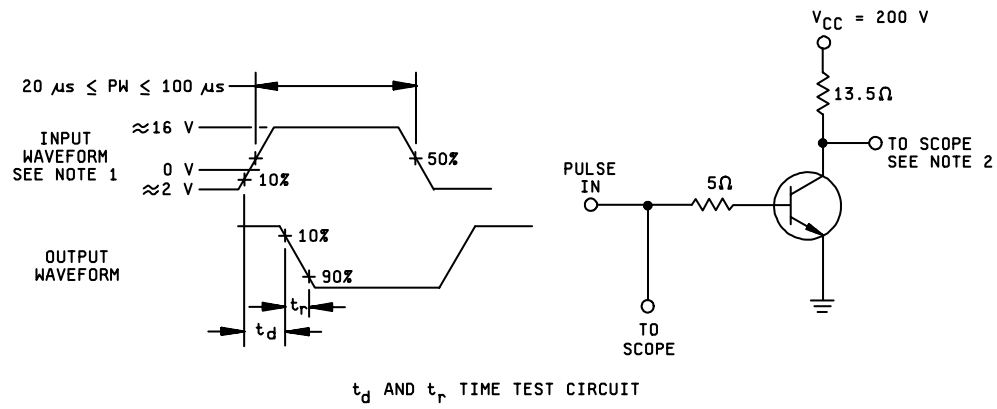
* FIGURE 8. Thermal impedance graphs (2N6691 and 2N6693).



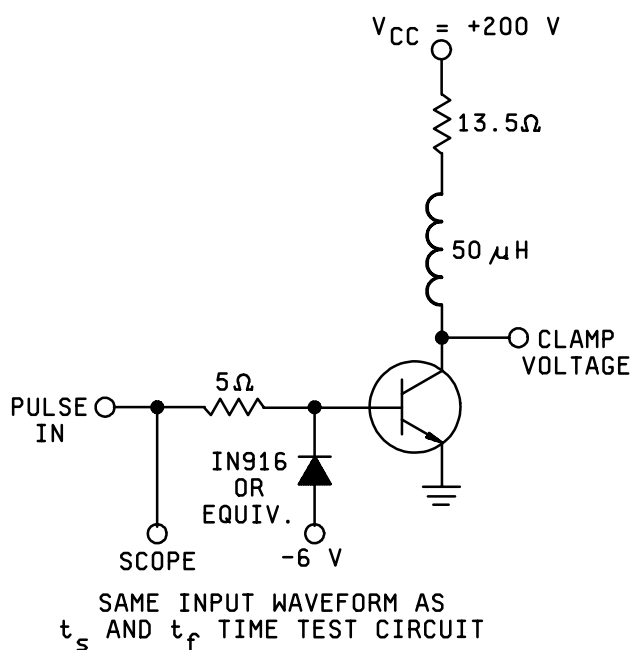
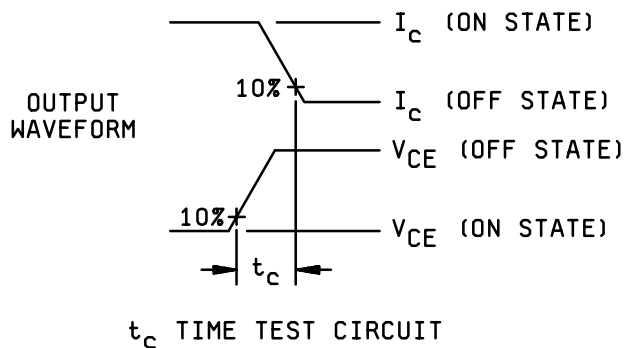
* FIGURE 9. Thermal impedance graphs (2N6676T1 and 2N6678T1).



* FIGURE 10. Thermal impedance graphs (2N6676T3 and 2N6678T3).



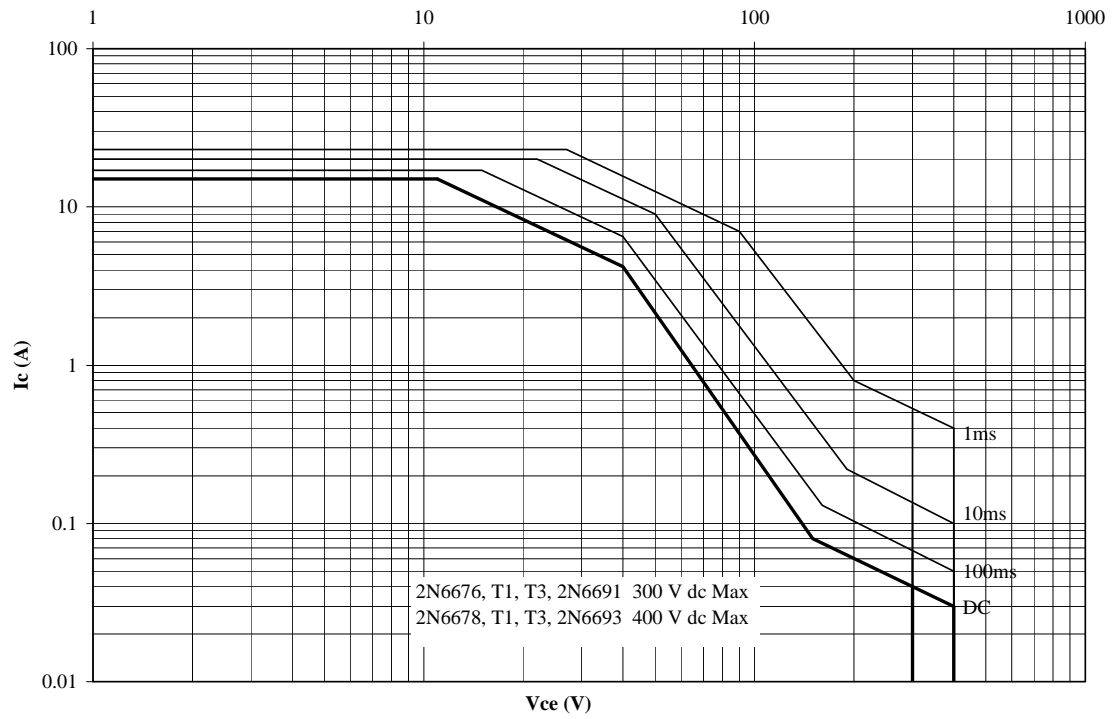
* FIGURE 11. Pulse response test circuit.



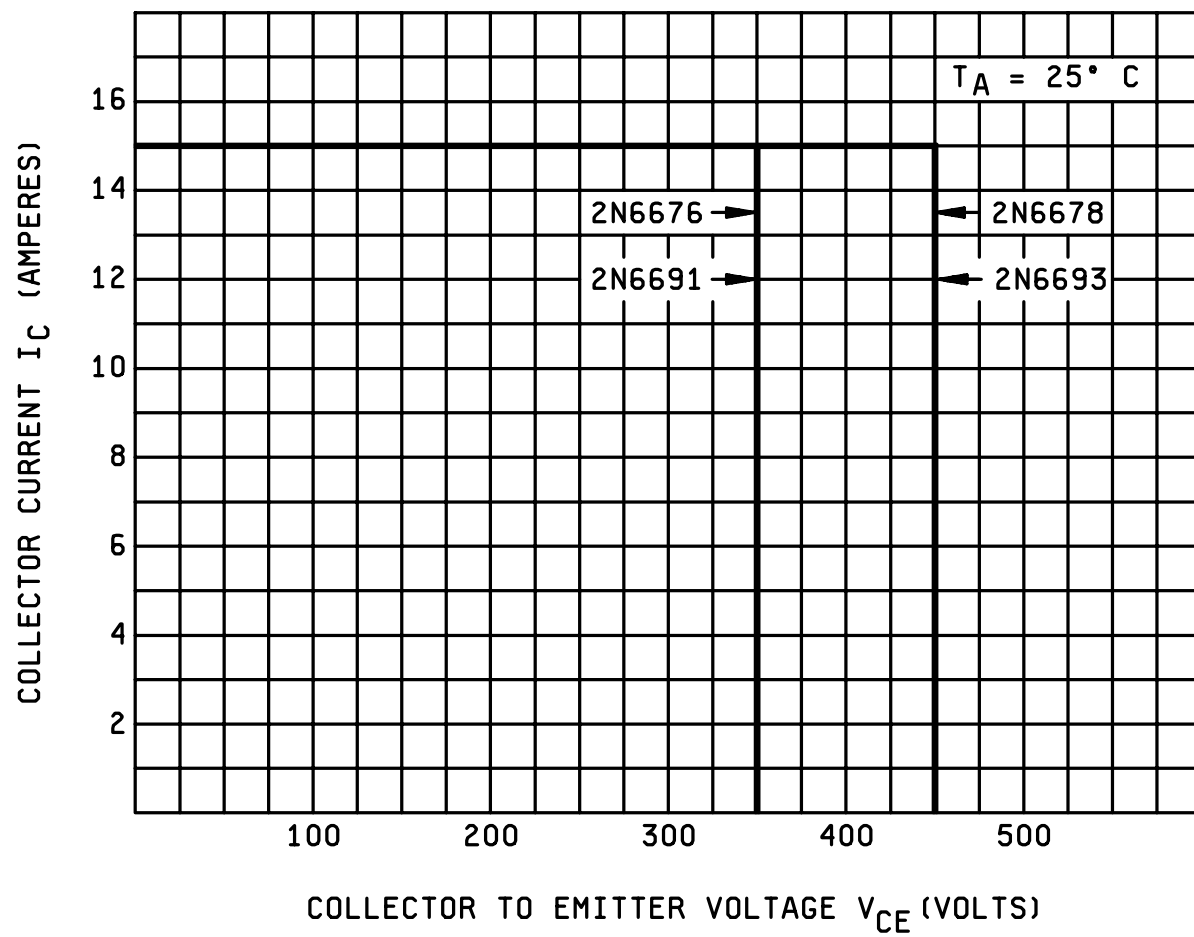
NOTES:

1. The rise time (t_r) of the applied pulse shall be ≤ 20 ns; duty cycle ≤ 2 percent; generator source impedance shall be 50 ohms.
2. Output sampling oscilloscope: $Z_{in} \geq 100$ k ohms; $C_{in} \leq 12$ pF; rise time ≤ 5 ns.

* FIGURE 11. Pulse response test circuits - Continued.



*FIGURE 12. Maximum safe operating graph (dc).



* FIGURE 13. Safe operating area for switching between saturation and cutoff (clamped inductive load) (all devices).

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Points' packaging activity within the Military Department or Defense Agency, or within the Military Departments' System Command. Packaging data retrieval is available from the managing Military Departments' or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Notes. The notes specified in MIL-PRF-19500 are applicable to this specification.

* 6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification.
- b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1).
- c. The lead finish (see 3.4.1).
- d. Type designation and quality assurance level.
- e. Packaging requirements (see 5.1).

* 6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturer's List QML-19500 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center Columbus, DSCC-VQE, P.O. Box 3990, Columbus, OH 43216-5000.

* 6.4 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

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Air Force - 11
DLA - CC

Preparing activity:
DLA - CC

(Project 5961-2613)

Review activities:
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Air Force - 19, 99

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I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER
MIL-PRF-19500/538B

2. DOCUMENT DATE
24 April 2003

3. DOCUMENT TITLE

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, POWER TYPE 2N6676, 2N6678, 2N6676T1, 2N6678T1, 2N6676T3, 2N6678T3, 2N6691 AND 2N6693 JAN, JANTX AND JANTXV

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

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8. PREPARING ACTIVITY

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